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Simultaneous Saccharification and Fermentation for D-Lactic Acid Production from Dried Distillers Grains with Solubles

Authors : Nurul Aqilah Mohd Zaini, Afroditi Chatzifragkou, Dimitris Charalampopoulos

Abstract : D-Lactic acid production is gaining increasing attention due to the thermostable properties of its polymer, Polylactic Acid (PLA). In this study, D-lactic acid was produced in microbial cultures using Lactobacillus coryniformis subsp. torquens as D-lactic acid producer and hydrolysates of Dried Distillers Grains with Solubles (DDGS) as fermentation substrate. Prior to fermentation, DDGS was first alkaline pretreated with 5% (w/v) NaOH, for 15 minutes (121oC/ ~16 psi). This led to the generation of DDGS solid residues, rich in carbohydrates and especially cellulose (~52%). The carbohydrate-rich solids were then subjected to enzymatic hydrolysis with Accellerase® 1500. For Separate Hydrolysis and Fermentation (SHF), enzymatic hydrolysis was carried out at 50oC for 24 hours, followed by fermentation of D-lactic acid at 37oC in controlled pH 6. The obtained hydrolysate contained 24 g/l glucose, 5.4 g/l xylose and 0.6 g/l arabinose. In the case of Simultaneous Saccharification and Fermentation (SSF), hydrolysis and fermentation were conducted in a single step process at 37oC in pH 5. The enzymatic hydrolysis of DGGS pretreated solids took place mostly during lag phase of L. coryniformis fermentation, with only a small amount of glucose consumed during the first 6 h. When exponential phase was started, glucose generation reduced as the microorganism started to consume glucose for D-lactic acid production. Higher concentrations of D-lactic acid were produced when SSF approach was applied, with 28 g/l D-lactic acid after 24 h of fermentation (84.5% yield). In contrast, 21.2 g/l D-lactic acid were produced when SHF was used. The optical pu rity of D-lactic acid produced from both experiments was 99.9%. Besides, approximately 2 g/l acetic acid was also generated due to lactic acid degradation after glucose depletion in SHF. SSF was proved an efficient towards DDGS ulilisation and D-lactic acid production, by reducing the overall processing time, yielding sufficient D-lactic acid concentrations without the generation of fermentation by-products.

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